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NOTES ON THE ALTITUDINAL RANGE OF FOREST FUNGI

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The altitudinal range of forest tree fungi is a subject of some interest to foresters, and one seldom touched upon in forest pathological reports. During the seasons from 1912 to 1915 the writer, in connection with other work in the higher elevations of the Pacific Northwest, gathered considerable information on this subject.

VEGETATION OF REGIONS VISITED

In most of the higher mountains in Washington, Oregon, Idaho, and Montana arctic conditions prevail during a part of the year. This is indicated by the occurrence of such heather-like plants as *Phyllodoce empetrifomis* (Smith) Don, *Ledum glandulosum* Nutt., *Vaccinium microphyllum* Ryd., *Rhododendron albi-florum* Hook., *Gaultheria humifusa* (Graham) Ryd., *Cassiope mertensiana* (Bong.) Don, and by the alpine character of numerous herbaceous plants. On a few of the higher peaks arctic conditions exist for the entire year. The absence on many slopes of a suitable amount of soil capable of supporting any great amount of vegetation is probably more responsible for their alpine character than elevation and exposure. The regions visited do, however, represent the highest of the timbered plant zones for the Northwest.

The characteristic tree which lends the true alpine character to all high elevations in the Northwest is the alpine fir (*Abies lasiocarpa* (Hook.) Nutt.). It is usually associated with the mountain or black hemlock (*Tsuga mertensiana* (Bong.) Carr.) This hemlock is not, however, universally distributed as is the alpine fir but occurs sparingly in certain regions. A tree that reaches the highest elevations and is quite generally mixed with the alpine fir is the white bark pine (*Pinus albicaulis* Engelm.).

The limber pine (*Pinus flexilis* James) is also a timber line tree in several regions visited, as is also the alpine larch (*Larix lyallii* Parl.). Other trees reaching well up into the subalpine zone are lodgepole pine (*Pinus contorta* Loud.), Engelmann spruce (*Picea engelmanni* Engelm.), and Douglas fir (*Pseudotsuga taxifolia* (Lam.) Britton), the latter often assuming most peculiar and grotesque shapes.

Although most of the higher elevations visited represent the timber line for the region, the fungi collected would be found at a much greater elevation farther south, since the altitude of the timber line varies with the latitude in that direction while the reverse is true to the northward. Specimens of forest tree fungi at hand from some of the mountain ranges to the south and from northern Alaska show this to be true.

FACTORS GOVERNING THE ALTITUDINAL RANGE OF FOREST FUNGI

In the course of the collection of fungi on high mountains many points of interest have been recorded. Certain species disappear with increasing elevation, some are chiefly associated with particular forest zones, while others are more cosmopolitan and are found in greater or less quantity at all elevations. Some species always occur in greater or less quantity under all conditions provided their hosts are present. For example, *Fomes pini* (Brot.) Lloyd and *Echinodontium tinctorium* E. & E. are always found to accompany their respective hosts to the absolute timber line. Both species primarily belong to the lower forest zones. Tubeuf¹ reports the occurrence of *Fomes pini* on *Pinus cembra* in the Bavarian Highlands at an elevation of 1700 m. (5610 feet).

In ascending a high mountain it is soon noticed that the number of fungous species, likewise their abundance, decreases with increasing elevation. Barring the demands on moisture this seems to be due to the influence of temperature. It is known that there is a particular optimum temperature for spore germination about which many species seem to oscillate. This may vary from the temperature at which the best mycelial growth of the

¹ Tubeuf, C. v. Notizen über die Vertikalverbreitung der *Trametes pini* und ihr Vorkommen an Verschiedenen Holzarten. Naturw. Zeitschr. f. Land- u. Forstw. 4: pp. 96-100.

same species occurs. Since in most cases new infections must originate from the spore, a species may be confined to that elevation and to those conditions of exposure where the most favorable temperature for spore germination exists for the greatest length of time. After becoming thoroughly established in the substratum the effect of this influence may not be so marked. A higher or lower temperature may then only serve to retard the activity of the mycelium and not endangered its existence. Some fungi, in fact, are truly alpine in habit and are not usually found growing below a certain elevation and will die if transferred to lower altitudes. This fact can be demonstrated experimentally as the following data will show.

By carefully transplanting (July 3, 1913) three seedlings each of alpine fir and white bark pine infected with *Herpotrichia nigra* Hartig and *Neopeckia coulteri* (Pk.) Sacc., respectively, from an elevation of 6735 feet (2052.8 m.) into lowland of 2500 feet (762 m.), the mycelia of these fungi after making an average growth of eight centimeters ceased altogether in August of the following year or thirteen months after the transfer. Both species died shortly afterward. The hosts continued to live. This result, though based on a single experiment, indicates that an average low temperature may be necessary for the development of these species.²

The coldest weather anywhere in the Northwest at any elevation is not sufficient to destroy the vitality of the sporophores of the common forest tree fungi. On the return of normal growing conditions, even though this period is short, all vital functions are resumed. The minimum temperature at which the sporophores of the common species are capable of withstanding is extremely low. Buller³ has demonstrated "that the fruiting bodies of

² An interesting fact brought out by this experiment was that the spores of each species produced in perithecia developed while in the new habitat did not undergo any change in color, shape, dimension, number of septa, or arrangement in the ascus different from the usual type of spore which has always characterized these plants as two distinct species.

³ Upon the retention of vitality by dried fruiting bodies of certain Hymenomycetes including an account of an experiment with liquid air. Trans. of the British Mycological Society. 1912. P. 112.

Also Buller and Cameron. On the temporary suspension of vitality in the

Schizophyllum commune, after having been kept dry and exposed to the air for two years and eight months, are able to retain their vitality when subsequently they have been dried *in vacuo* by the phosphorus pentoxide and charcoal-bulb liquid air method and subjected to the temperature of liquid air (-190° C.) for three weeks." This shows the wonderful powers of resistance against drought and cold by this species. The same author demonstrated that a number of the sporophores of the common wood-destroying fungi have the ability to withstand very low temperatures. It is interesting to note in the list at the end of this article that the xerophilous species are well represented in high altitudes.

With regard to the form and general development of the aerial parts of the larger fungi in high mountains, there are many analogies with the higher plants. Some species have developed special structures in order the better to withstand the drying winds of high elevations. *Polyporus leucospongia* Cke. is a notable example of this. It has been observed that the spongy layer of the sporophore retains moisture for a considerable period following a rain. This aids in keeping the sporophore moist and furthers its development. Perennial polypores under alpine conditions are usually distinguished from the same species in the lowlands by their small size, different color, inclination to the resupinate form, and a hard context. The sporophores of *Fomes pini* at high elevations are small and either appear just under branches or in a poria-like form in the clefts of the bark. Fungi in well protected sites as compared to those in the arid wind-swept areas are larger and there is a greater variety and number of species. Up to an elevation of about 4000 feet (1219 m.) there is practically no difference in the position or location on their substrata of the wood-destroying fungi. Sporophores occur quite promiscuously on fallen trunks or high up on standing trees. At 4000 to 5000 feet elevation the sporophores of *Echinodontium tinctorium* and *Fomes pini* may occur as high up on their hosts as in the lowlands depending upon the height, size, and age of the trees. With increasing elevation the sporophores fruit bodies of certain Hymenomycetes. Trans. of the Royal Soc. of Canada. Third series. 6: pp. 73-75. 1912.

of these and other species growing on standing trees are usually found nearer the earth.

It is very evident that the occurrence of fungi, particularly the fleshy species, in elevated regions is closely correlated with the ratios of evaporation and precipitation. The excessive precipitation in the form of rain and snow is counteracted by the rapid evaporation from all substrata except in the more protected places or on north slopes. The influence of topography in this respect tends to produce a wide variation in the fungous flora in very narrow confines. Rounded peaks have many exposures. Consequently, fungous associations on the same mountain may be widely different. Though trees may be present on exposed wind-swept sites, all classes of fungi except a few perennials or species with special adaptation are usually absent. Those that do occur on such sites, if not found to be entirely different species from those occurring in protected exposures where the snow collects, are often so modified that they could well be classed as biological forms. Some of the fungi usually characterizing exposed sites are *Lentinus lepideus* Fr., *Lenzites sepiaria* (Wulf.) Fr., *Polystictus hirsutus* Fr., *Polyporus leucospongia* Cke., and certain *Patellea* species. The greater amount of snow on protected sites prevents the radiation of heat from the substrata, hence prevents evaporation and desiccation and usually promotes the development of certain fungi, particularly the more fleshy wood-destroying species. On the other hand, annual sporophores may be entirely absent under the more extreme conditions owing to the fact that snow shortens the period of vegetative growth or the weight and movement of snow is too great to be sustained.

Any factor that influences the cellular and chemical development of the wood of a tree may influence the growth of some wood-destroying fungi, hence their distribution. Aside from the moisture relation which is always a factor in promoting the growth of fungi, the influence of elevation on the chemical and anatomical structure of forest trees is a well known phenomenon and in a measure determines their predisposition to disease. According to Weber⁴ the organic content of larches and beeches

⁴ Einfluss des Standortes auf die Zusammensetzung der Asche von Lärchen. Allgem. Forst- u. Jagdzeitung. P. 367. 1873.

regularly increases with increase in elevation with exactly the reverse for the mineral substances. With increasing elevation, certain anatomical changes in forest trees such as narrower rings imparting a hard flinty condition to the heartwood,⁵ tend to reduce their disposition to disease. The influence of high mountain conditions on the prevalence of fungi is more noticeable in the case of leaf and twig diseases because of certain modifications of the host which makes attack by parasites difficult. The foliage of forest trees and other plants at high elevations is usually greatly modified to withstand arid conditions. This modification is generally expressed by a thicker epidermis, excessive development of hairs and waxy coverings and, no doubt, retards and in many cases absolutely prevents infection. Very few endophytic leaf parasites have been collected at high elevations. On the other hand, epiphytic species are more common. With the reverse of these conditions in the lowlands the same species may be and usually are more seriously attacked by fungi. The difficulty experienced in the cultivation of the larch in the lowlands of Germany owing to the increased destructiveness of *Dasyscypha Willkommii* Hartig is a case in point.

Any forest tree with a great altitudinal range is more severely attacked by fungi at its lowest elevation. As examples, grand fir (*Abies grandis* Lindl.), western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), and alpine fir, particularly show this to be true. The problems of management with regard to forest tree diseases in the highest elevations at which merchantable forests can be grown will never be as difficult as at lower levels. The fact that the tree species will be more or less separated into their component types will not at this elevation be as serious a factor in promoting the spread of fungous diseases as at lower elevations. The big problem at low elevations in reducing the ravages of fungi is to find the environment best suited for the several species

Einfluss des Standortes auf den Aschengehalt des Buchenlaubes. Allgem. Forst.- u. Jagdzeitung. P. 221. 1875.

Also Cieslar, A. Über den Ligningehalt einiger Nadelhölzer. Mitt. a. d. Forst. Versuchswesen Oesterreichs. v. 23: 1897.

⁵ Rosenthal, M. Über die Ausbildung der Jahresringe an der Grenze des Baumwuchses in den Alpen. Cit. Bot. Centralbl. nr. 43. 1904. Sendtner, Vegetationswerk. Sudbayerns. P. 555.

at that elevation. Trees growing in an unfavorable environment are invariably more seriously diseased. To attempt the development of a pure larch forest on low undrained soil is to give it over to serious decay.

Until the time comes to practice silviculture in the higher elevations the search for the greatest altitudinal range for our common forest fungi is chiefly of mycological interest. Recent studies show that many of the species found at all elevations are of greatest economic importance at particular elevations and in particular forest zones as influenced by physical environment. It is entirely possible in restricted areas to group the forest fungi of greatest economic importance with regard to amount of damage done according to the different forest zones. For example, in northern Idaho, *Fomes pini*, *Polyporus schweinitzii*, *Fomes annosus*, *Echinodontium tinctorium*, *Armillaria mellea* are of far greater importance in point of damage done in the white pine zone than in any other. The problem then is to search out the factors which govern the prevalence and distribution of fungi in the several forest types and balance them in such a way as to produce the best possible results in tree growth.

FUNGI COLLECTED AT HIGH ELEVATIONS

The following is a list of fungi either collected or observed at high elevations in the principal mountain regions of the Northwest between 44° to 49° latitude and 109° to 124° longitude. From the fact that most of the common genera are represented, a special and detailed search at different seasons would, no doubt, reveal a far greater number of species than here recorded. The species here listed with the exception of those entirely confined to high elevations have not been found in abundance but occur only occasionally. Although numbered among them are many of the most destructive species of lower forest zones, they have not been found to cause any great damage to forest growth at high elevations over large areas. It is proposed to add to this list as the explorations continue.

TABLE I.—*Showing the Highest Elevation at Which Some Common Forest Fungi have been Found, Giving Host, Mountain Range, and Peak where Observation was Made*

(Region between 44° and 49° latitude and 109° and 124° longitude)

Name of fungus	Host	Mountain range and peak	Elevation	
			Feet	Me- ters
<i>Armillaria mellea</i> (Vahl.) Quel.	<i>Abies lasiocarpa</i>	Selkirks; Mt. Casey	6735	2052
<i>Calyptospora columnaris</i> (A. & S.) Kuhn.	<i>Vaccinium microphyllum</i>	Selkirks; Smith Peak	5650	1722
<i>Chlorosplenium aeruginosum</i> Fr.	Fallen twigs	Selkirks; Mt. Casey	6735	2052
<i>Corticium lividum</i> Pers.	<i>Picea engelmanni</i>	" " "	6735	2052
<i>Corticium laetum</i> Karst.	<i>Alnus tenuifolia</i>	" " "	6735	2052
<i>Corticium corrugé</i> Burt.	<i>Abies lasiocarpa</i>	St. Joe Mts.; Marble Mt.	6580	2005
<i>Coleosporium solidaginis</i> (Schw.) Thum.	<i>Aster cusickii</i>	Blue Mts.; Huckleberry Mt.	4911	1496
<i>Coniophora arida</i> Fr.	<i>Picea engelmanni</i>	Selkirks; Smith Peak	6000	1828
<i>Cronartium comandrae</i> Pk.	<i>Comandra pallida</i>	Bitter Root Mts.; Mt. Sentinel	5801	1768
<i>Cytospora translucens</i> Sacc.	<i>Salix</i> sp.	Selkirks; Smith Peak	7650	2331
<i>Dacryomyces aurantia</i> Schw.	<i>Pseudotsuga taxifolia</i>	" " "	4650	1417
<i>Daedalea unicolor</i> Bull.	<i>Alnus tenuifolia</i>	" " "	4650	1417
<i>Daldinia concentrica</i> Bolt.	<i>Alnus tenuifolia</i>	" " "	4650	1417
<i>Diatrype bullata</i> (Hoff.) Fr.	" " "	" " "	7650	2331
<i>Echinodontium tinctorium</i> E. & E.	<i>Abies lasiocarpa</i>	Cascades; Mt. Baker	7500	2286
<i>Echinodontium tinctorium</i> E. & E.	" "	Selkirks; Smith Peak	7450	2270
<i>Echinodontium tinctorium</i> E. & E.	<i>Abies concolor</i>	Blue Mts.; Huckleberry Mt.	5000	1524
<i>Echinodontium tinctorium</i> E. & E.	<i>Abies grandis</i>	Cabinet; Scotchman Peak	5250	1600
<i>Exidia glandulosa</i> Bull.	<i>Salix</i> sp.	Selkirks; Smith Peak	4200	1280
<i>Exobasidium vaccinii</i> (Fckl.) Wor.	<i>Vaccinium membranaceum</i>	Selkirks; Bald Mt.	4000	1219
<i>Exobasidium vaccinii</i> (Fckl.) Wor.	<i>Vaccinium microphyllum</i>	Selkirks; Smith Peak	7650	2331
<i>Fomes annosus</i> Fr.	<i>Pinus albicaulis</i>	" " "	7420	2260
<i>Fomes igniarius</i> Lin.	<i>Alnus tenuifolia</i>	" " "	7420	2260
<i>Fomes officinalis</i> Fr.	<i>Pseudotsuga taxifolia</i>	Selkirks; Mt. Casey	6735	2052
<i>Fomes pini</i> Brot.	<i>Pinus albicaulis</i>	" " "	6735	2052
" " "	" "	Cascades; Mt. Baker	7500	2286
" " "	<i>Pinus contorta</i>	Selkirks; Mt. Casey	6735	2052
" " "	<i>Abies lasiocarpa</i>	Continental Divide; Mudd Creek	7250	2209
<i>Fomes pinicola</i> Swartz	<i>Pinus albicaulis</i>	Selkirks; Mt. Casey	6735	2052
" " "	" "	Cascades; Mt. Baker	7600	2316
" " "	<i>Pinus flexilis</i>	Continental Divide; Mt. Haggin	8500	2590

TABLE I.—(Continued.)

Name of fungus	Host	Mountain range and peak	Elevation	
			Feet	Me- ters
<i>Grandinia granulosa</i> Pers.	<i>Larix lyallii</i>	Continental Divide; Mt. Haggin	8500	2590
<i>Geaster hygrometricus</i> Pers.	Well submerged in soil	Cascades; Mt. Baker	7000	2133
<i>Herpotrichia nigra</i> Hartig	<i>Tsuga mertensiana</i>	St. Joe Mts.; Marble Pk.	6580	2005
<i>Herpotrichia nigra</i> Hartig	<i>Picea engelmanni</i>	Continental Divide; Mt. Haggin	7500	2286
<i>Herpotrichia nigra</i> Hartig	<i>Abies lasiocarpa</i>	Bitter Root Mts.; Tiger Peak	6635	2022
<i>Herpotrichia nigra</i> Hartig	" "	Selkirks; Mt. Casey	6735	2052
<i>Hirneola auricula-</i> <i>Judae</i> Lim.	" "	Cascades; Mt. Baker	6500	1981
<i>Hymenochaete taba-</i> <i>cina</i> Sow.	<i>Alnus tenuifolia</i>	Selkirks; Mt. Casey	6700	2042
<i>Hymenochaete corru-</i> <i>gata</i> Lev.	" "	" " "	6700	2042
<i>Irpex lacteus</i> Fr.	" "	Selkirks; Bald Mt.	6228	1898
<i>Lachnella</i> sp.	<i>Picea engelmanni</i>	" " "	5228	1593
<i>Lentinus lepideus</i> Fr.	<i>Abies lasiocarpa</i>	Selkirks; Mt. Casey	6735	2052
<i>Lenzites sepiaria</i> Fr.	<i>Pinus albicaulis</i>	Cascades; Mt. Baker	7500	2286
<i>Lophodermium pinastri</i> Schröd.	<i>Pinus monticola</i>	St. Joe Mts.; Marble Mt.	5000	1524
<i>Melampsora bigelowii</i> Thum.	<i>Salix</i> sp.	Selkirks; Smith Peak	5600	1706
<i>Microsphaera diffusa</i> C. & P.	<i>Ledum glandulosum</i>	Cascades; Mt. Baker	5000	1524
<i>Merulius aureus</i> Fr.	<i>Pinus contorta</i>	Selkirks; Mt. Casey	6735	2052
<i>Merulius neveus</i> Fr.	<i>Alnus tenuifolia</i>	" " "	6735	2052
<i>Neopeckia coulteri</i> (Pk.) Sacc.	<i>Pinus contorta</i>	Continental Divide; Mt. Haggin	8000	2438
<i>Neopeckia coulteri</i> (Pk.) Sacc.	<i>Pinus albicaulis</i>	Cascades; Mt. Baker	7500	2286
<i>Neopeckia coulteri</i> (Pk.) Sacc.	<i>Pinus flexilis</i>	Continental Divide; Mt. Haggin	8000	2438
<i>Patella</i> sp.	On wind eroded wood	Cabinet; Scotchman Peak	7011	2136
<i>Peniophora crassa</i> Burt	<i>Picea engelmanni</i>	Selkirks; Smith Peak	6200	1834
<i>Peniophora globifera</i> E. & E.	" "	" " "	6200	1834
<i>Peniophora carnosa</i> Burt	<i>Abies lasiocarpa</i>	St. Joe Mts.; Monu- mentals	6500	1981
<i>Peridermium colora-</i> <i>dense</i> (Diet.) Arth. & Kern.	<i>Picea engelmanni</i>	Selkirks; Bald Mt.	5100	1554
<i>Peridermium balsa-</i> <i>meum</i> Pk.	<i>Abies lasiocarpa</i>	Cascades; Mt. Baker	6000	1828
<i>Phlebia cinnabarina</i> Schw.	<i>Alnus tenuifolia</i>	Cabinet; Scotchman Peak	7000	2133
<i>Phragmidium occi-</i> <i>dentale</i> Arth.	<i>Rubus nutkana</i>	Selkirks; Mt. Casey	6300	1920
<i>Phragmidium Rosae-</i> <i>acicularis</i> Liro	<i>Rosa sayi</i>	" " "	5000	1524

TABLE I.—(Continued.)

Name of fungus	Host	Mountain range and peak	Elevation	
			Feet	Me- ters
Phyllactinia corylea (Pers.) Karst.	Alnus tenuifolia	Bitter Root Mts.; Grizzly Peak	5977	1821
Polyporus amorphus Fr.	Picea engelmanni	Selkirks; Mt. Casey	6000	1828
Polyporus alboluteus Ellis	Larix lyallii	Bitter Root Mts.; Shattuck Mt.	7580	2310
Polyporus benzoinus Fr.	Tsuga mertensiana	St. Joe Mts.; Monu- mentals	6900	2103
Polyporus lucidus Leysser	" "	St. Joe Mts.; Marble Mt.	6000	1828
Polyporus picipes Fr.	Alnus sp.	Cascades; Mt. Baker	7000	2133
Polyporus leucospongia Cke.	Pinus contorta	St. Joe Mts.; Monu- mentals	6979	2127
Polyporus perennis L.	Ground	Continental Divide; Mt. Haggin	8500	2590
Polyporus tomentosus Fr.	"	Blue Mts.; Rock Creek Butte	8000	2438
Polyporus schweinitzii Fr.	Pseudotsuga taxifolia	Selkirks; Mt. Casey	6735	2052
Polyporus schweinitzii Fr.	Pinus albicaulis	Continental Divide; Sullivan Peak	8150	2484
Polystictus abietinus Dicks.	" "	Continental Divide; Mt. Haggin	8500	2590
Polystictus hirsutus Fr.	Alnus tenuifolia	Selkirks; Smith Peak	7650	2331
Polystictus versicolor L.	Pinus albicaulis	Selkirks; Smith Peak	7650	2331
" " "	Abies lasiocarpa	Cascades; Mt. Baker	7600	2316
Poria attenuata Pk.	Tsuga mertensiana	St. Joe Mts.; Marble Mt.	6580	2005
Puccinia calthae Lk.	Caltha biflora	Cascades; Mt. Baker	8000	2438
Pucciniastrum myrtelli (Schum.) Arth.	Vaccinium micro- phyllum	Blue Mts.; Huckle- berry Mt.	4911	1496
Pucciniastrum pustu- latum (Pers.) Diet.	Epilobium alpinum	St. Joe Mts.; Monu- mentals	4979	1517
Rhytisma arbuti Phill.	Menziesia sp.	Cascades; Mt. Baker	7600	2316
Scleroderma cepa	Embedded in earth	St. Joe Mts.; Monu- mentals	6979	2127
Solenia sp.	Betula glandulosa	Selkirks; Smith Peak	7000	2133
Stereum ambiguum	Abies lasiocarpa	" " "	7650	2331
Stereum fasciatum	Alnus tenuifolia	" " "	7650	2331
Stereum sanguinolent- um A. & S.	Tsuga mertensiana	St. Joe Mts.; Marble Mt.	6580	2005
Stereum sulcatum Burt	Picea engelmanni	Selkirks; Smith Peak	6325	1927
Trametes carnea Nees	Pinus contorta	Selkirks; Mt. Casey	6735	2052
Trametes heteromorpha	Abies lasiocarpa	Continental Divide; Mt. Haggin	8000	2438
Trametes serialis Fr.	Pinus contorta	Continental Divide; Mt. Haggin	9988	3044
Trametes setosus Weir	" "	Continental Divide; Mt. Haggin	8000	2438
Uredinopsis Pteridis Diet. & Holw.	Pteridium aquilinum pubescens	Selkirks; Mt. Casey	5735	1748
Uredo holwayi Arth.	Tsuga mertensiana	St. Joe Mts.; Monu- mentals	4900	1493
Uropyxis sanguinea Pk. & Arth.	Berberis aquifolium	Selkirks; Mt. Casey	5735	1748

SUMMARY

Most forest fungi have a great altitudinal range, being found from sea level to the extreme limits of the timbered zones.

Most of the common forest fungi are found at the highest timbered zones but are not so abundant as at lower elevations.

Certain of the more economic species predominate in particular forest zones or types.

Some species are strictly alpine in habit and are not found below certain elevations and exhibit particular adaptation to their environment.

With increasing elevation the sporophores of certain fungi predominating in lower forest zones exhibit many changes in form, structure, and in mode and place of attachment. The great variation in the temperature and moisture relation induced by the diversity of high mountain regions may greatly influence the development of the aerial parts of wood-destroying fungi but may not materially influence their development within the substratum.

The influence of high mountain conditions on the form and structure of host plants in turn influence the growth of their fungous parasites.

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